

ARTICLE

Creating and using educational resources to improve practical teaching in the Human Physiology subject on the bachelor's degree course in Physical Activity and Sports Sciences. Assessment of results

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Submitted in: January 2013

Accepted in: April 2013

Published in: January 2014

Recommended citation

Olmos, G., Ruiz-Torres, M.P., Calleros, L., Cortés, M.A., de Frutos, S., Ospina, R. & Rodríguez-Puyol, M. (2014). Creating and using educational resources to improve practical teaching in the Human Physiology subject on the bachelor's degree course in Physical Activity and Sports Sciences. Assessment of results. *Revista de Universidad y Sociedad del Conocimiento (RUSC)*. Vol. 11, No 1. pp. 108-127. doi <http://dx.doi.org/10.7238/rusc.v11i1.1757>

Abstract

The need to advance towards a methodology that strengthens self-directed learning and competency development among students has become a key focus of university teaching in recent years. This focus has given rise to new methodological strategies that have been enhanced by the use of information and communication technologies (ICTs). Within the progress of these methodological strategies, the creation of educational resources that help to meet their objectives has become an important part of the work done by university lecturers. Along those lines, a group of lecturers in the Department of Physiology at the University of Alcalá (UAH), Spain, has created a series of educational resources using visual online tools for practical teaching in the Human Physiology subject. These resources were used for the first time in the 2011/12 academic year in the Human Physiology subject, taught in the first year of the bachelor's degree course in Physical Activity and Sports Sciences. This article presents the resources created and the methodology used. The results obtained from their use are also assessed; these results refer to the students' satisfaction with the resources, and the contribution that the resources and the methodology made to the students' learning. A survey was conducted to ascertain the students' opinions, and a comparative analysis was performed of the grades obtained by the students in the practical part of the subject and their impact on the overall grade, and those obtained in the previous academic year when the resources had not been used. The results show that the students were satisfied with both the educational resources and the methodology used, and that there was a significant improvement in the grades obtained in comparison to the previous academic year.

Keywords

human physiology, educational resources, methodological innovation, assessment

Elaboración y empleo de materiales didácticos para la mejora de la enseñanza práctica en la asignatura de Fisiología Humana en el grado de Ciencias de la Actividad Física y del Deporte. Evaluación de resultados

Resumen

La necesidad de caminar hacia una metodología que potencie el aprendizaje autónomo y el desarrollo de las competencias en el alumno se ha convertido en estos últimos años en un elemento clave en la enseñanza universitaria. Esta constante ha impulsado el auge de nuevas estrategias metodológicas que se han visto dinamizadas por el uso de las nuevas tecnologías. Dentro del progreso de estas metodologías, la elaboración de materiales didácticos que favorezcan estos objetivos ha sido y sigue siendo una pieza importante de trabajo entre los docentes universitarios. En esta línea, un grupo de profesores del Departamento de Fisiología de la universidad hemos elaborado una serie de materiales didácticos empleando herramientas visuales y virtuales, para la enseñanza práctica de la asignatura Fisiología Humana. Estos materiales

se utilizaron por primera vez durante el curso 2011-12 en la asignatura Fisiología Humana de primer curso del grado de Ciencias de la Actividad Física y del Deporte (CCAFyDE). En este trabajo presentamos los materiales elaborados y la metodología utilizada. También evaluamos el resultado obtenido tras su empleo en cuanto a la satisfacción del alumno y a la contribución que estos materiales y tal metodología han tenido para el aprendizaje de los estudiantes. Para ello se realizó una encuesta entre los alumnos y un análisis comparativo de las calificaciones obtenidas en la parte práctica de la asignatura y de su impacto en el conjunto de la nota total de esta misma, con respecto a las notas obtenidas por los estudiantes del curso anterior, en el que no se utilizaron estos materiales. Los resultados indican una aceptación satisfactoria por parte de los alumnos tanto de los materiales didácticos como de la metodología empleada, así como una mejora significativa en sus calificaciones con respecto al curso anterior

Palabras clave

Fisiología Humana, materiales didácticos, innovación metodológica, evaluación

Introduction

For several years, Spanish universities have been grappling with change processes within the context of the European Higher Education Area (EHEA). Of particular importance in those processes is advancement towards the kind of teaching that strengthens self-directed learning and competency development among students, where competencies are understood as a combination of skills, knowledge and attitudes that are suited to the jobs that students will eventually do. It is therefore crucial to create new teaching methodologies that are dynamic enough to cope with continuous improvement. In particular, these methodologies should ensure that the teaching-learning processes strengthen the students' responsible, active role and greater participation in the development of knowledge and skills (Zabalza, 2003-4), which will ultimately enable them to create their own learning processes (Prudencia Gutiérrez et al., 2011).

This requires the development of new ways of creating and conveying information, such as strengthening the use of online, digital and audiovisual tools, etc., and ultimately creating new methodologies and improving the use of new technologies applied to teaching (Salinas, 2004). The process requires students to take a more active part in their own learning processes, and it should therefore aim to strengthen their communication, information-searching and teamwork skills (Zabalza, 2003-4; Bartolomé Pina, 2008; Adell Segura & Castañeda Quintero, 2010). In addition, it should consider strategies that strengthen interaction between lecturers and students, and among students, as that seems to be an aspect that information and communication technologies (ICTs) have yet to resolve (Flores & De Arco, 2012).

The need for innovation has gradually developed over the past few years, during which time many varied initiatives have been implemented in a range of disciplines (Area Moreira, 2005; Margalef et al., 2007; Prudencia Gutiérrez et al., 2011). These experiences have shown that using new strategies and methodologies to facilitate and improve the students' learning, to teach them to learn and to develop their own learning is fundamental to any form of improvement in the teaching-learning process.

For several years, the development of new educational resources in digital format has been one of the innovations that many lecturers have strengthened the most. The use of these resources has been found to yield good results with regard to understanding and acquiring the required knowledge, as well as reinforcing other competencies (Carranza & Celaya, 2003). In addition, it has been shown that having educational resources available in multimedia or other presentation formats is a simple, practical way of conveying information, of making it accessible to students, thus aiding the students' understanding and strengthening their self-directed work. Over the years, guidelines and criteria have been given for creating such resources. As the process is dependent on experience in and the rapid development of new technologies, the resources have been adapted to foster the acquisition of the competencies that each discipline requires (Area Moreira 2005; Prendes et al., 2008).

In scientific disciplines in general, and in a subject like Human Physiology in particular, innovation in teaching through the use of educational resources has been ongoing for several years in a wide variety of initiatives (García & Lauretta, 2008; Gallego Fernández et al., 2008; Pagés, 2007; Pagés et al., 2011; Prendes et al., 2008).

In the field of Human Physiology, practical teaching is crucial in terms of ensuring that students learn the subject properly. Practical teaching allows students to come into direct contact with the real aspects of the subject matter, and with the observation and analysis methods through which knowledge is acquired. Furthermore, it represents a complement and an extension to theory classes, together forming a whole. Well-designed, high-quality practical classes can help to arouse or confirm the students' interest in or enthusiasm or passion for the subject, as they can provide a stimulating feeling of discovery and substantiation. In addition, practical teaching in the Human Physiology subject enables competencies other than cognitive ones to be acquired. These include the development of abilities and skills such as teamwork, the capacity to summarise, and the ability to produce and interpret results, all of which will be crucial to students in their working lives. Regarding the scheduled practicals for this subject, the students customarily have to do practical exercises selected by the lecturers, who will have explained the theory and procedure to be followed beforehand. As a result, the students are simply actors following a script written by the lecturers. This method of practical teaching has been found to be passive and not very stimulating; it has also been shown not to foster the development of the necessary competencies among students.

Bearing the above in mind, and from our experience of practical teaching in this subject, we felt that it was necessary to introduce an innovative change in the methodology used for practical teaching that would strengthen the students' active participation. This change involved establishing a work procedure that would incorporate new technologies and foster research and self-directed learning. To that end, a series of educational resources were developed to encourage the students to:

- Approach their learning through a more active and participatory methodology.
- Become more independent in their work, particularly in their preparation of, critical attitudes towards and discussions about it.
- Adopt a learning method that induces them to conduct research and integrate knowledge, to relate different aspects of it, and to be capable of drawing on and applying it to situations that are likely to arise in their working lives.

These resources were made available to the students on the university's virtual learning environment (VLE) while undertaking the subject, so that they could work on them before doing their practicals. After doing their practicals, the students' levels of satisfaction with the resources and the methodology were assessed, as was the impact of using the resources in the learning process by analysing the grades obtained by the students and comparing them to those obtained in the previous academic year when the resources had not been used.

Objective

This study had a two-fold objective:

- Firstly, to create a series of educational resources (scripts and videos) and make them available to the students via Blackboard – the university's Virtual Classroom VLE – to support them in doing their practical activities. The context in which the practicals were done was the Human Physiology subject, taught in the first year of the bachelor's degree course in Physical Activity and Sports Sciences.
- Secondly, to assess the impact of implementing the resources by conducting a survey to collect the students' opinions of them, and by performing a comparative analysis of the grades obtained by the students and those obtained in the previous academic year when the resources had not been used, in order to estimate the extent to which the resources had helped to improve practical teaching in the subject as whole.

Description and criteria for creating the educational resources

Within the framework of the EHEA, the proportion of European Credit Transfer and Accumulation System (ECTS) credits allocated to laboratory practicals in accordance with the university's criteria for the new bachelor's degree course in Physical Activity and Sports Sciences is around five percent of the subject's six ECTS credits. These credits are split between five 90-minute practicals. For the purposes of this study, the educational resources were made available for use in three practicals, which were selected in accordance with the criteria of usefulness and relevance to the theoretical content of the subject:

- Measuring blood pressure.
- Interpreting electrocardiogram (ECG) results.
- Interpreting spirometry results.

The following resources were created for each of these practicals:

- An audiovisual tutorial (images with voiceover) specifying the following (the original Spanish text has been translated into English here):

A series of different practicals will be done throughout the academic year. They cover important aspects of human physiology and will enable you [the student] to get a pretty good idea of some of the procedures used to measure bodily functions. At the start of each academic year, you will find the specific practicals to be done in the Assignments folder for practicals.

The following video gives a clear, concise explanation of how to prepare for and do the practicals in this subject. For each practical, you [the student] will need to do some prior research, which will be assisted by a script that will guide you through both the research process and the learning process. The script comprises several sections, the content of which is detailed below:

- The objectives pursued by the Physiology practical and related theoretical areas of the syllabus.
 - Information on theoretical content for which resources are available (in audiovisual and text format), relating to the basic theoretical concepts that students need to be aware of before doing the practical. The students are responsible for watching and working with these resources, although they can look for others themselves. Bibliographic sources are provided for that purpose.
 - A protocol: a step-by-step explanation of how to do the practical work is given.
 - Guidelines for producing the results: how to process and analyse the data, how long it should take and how to present the results.
 - A test to assess the quality of the resources and the use made of them by the students.
- A script in PDF format for each practical, containing the following sections:
 - A preparatory questionnaire about the theoretical concepts of the practical, which will guide the students through the research process relating to information searching before doing the practical.
 - The conceptual basis, which contextualises the practical within the subject content.
 - A protocol that the students need to follow to do the practical.
 - A chronological description of how the practical progresses.
 - A guide for presenting the results that the students obtain: tabulating results, performing statistical analyses and designing graphics.
 - A slide-show presentation of the script content to ensure that the students have a tool that provides them with a quick refresher of the information that they need to assimilate. Scientific videos are included, which give detailed explanations of the practical procedures to be carried out. Some examples of the images from the videos created for the practicals are shown below:



Illustration. Examples of images from the videos created for the practicals

- Links to web sites containing scientific content, which the students may find useful in preparing for the practicals, although their use is not compulsory. In order to get these links, the following activities were carried out: a) searching in official, reliable sources of information (PubMed, EBSCO, library, other universities and libraries, networks of virtual learning objects, etc.); b) filtering and selecting suitable links for the practical (done by a peer academic advisor); c) reviewing, summarising and adding value to the linked resources (done by the teaching staff). The final list of links to websites is summarised in Table 1.

Table 1. Websites selected for their scientific content

BLOOD PRESSURE	http://www.nejm.org/doi/full/10.1056/NEJMvcm0800157#figure=preview.gif http://www.sumanasinc.com/webcontent/animations/content/bloodpressure.swf http://www.medindia.net/animation/blood-pressure.swf http://mrhardy.wikispaces.com/Blood+Pressure.swf http://catalog.nucleusinc.com/interactive/high_blood_pressure.swf http://web.diabetes.org/link/link_for_life/03screen3.swf http://www.seh-lelha.org/swf/hipertension.swf Online course: http://www.csuchico.edu/atep/bp/bp.swf
ELECTROCARDIOGRAM	<i>Electrocardiogram:</i> http://healthlibrary.epnet.com/GetContent.aspx?token=0fcfa67b-a10e-40af-bef6-3c0b92e23cdf&chunkid=104075 Electrical conduction system of the heart: http://www.nhlbi.nih.gov/health/health-topics/animate/flash-electrical.swf http://www.bhf.org.uk/swfs/hearthealth/ecg.swf http://www.orthosports.info/multimedia/electrocardiogram/Electrocardiogram.swf <i>Cardiac cycle:</i> http://chs.sd57.bc.ca/~jbleecker/science/bi12ppt/Bio12_2/C13_Circulatory%20System_Newer/cardiac.swf http://www.wisc-online.com/objects/ap2304/ap2304.swf
SPIROMETRY	http://qs1252.pair.com/monarchm/elsevier/mao_v2/www-convert/rich_media/6210209/player.swf?1294931209000 http://www.iesvirgen.com/images/stories/dep_biolologia/Biolopage/Materiales/spirometry_spa.swf

Method

Description of the student sample

This study was conducted on students taking the Human Physiology subject, a six-credit basic-training type course taught in the first year of the bachelor's degree course in Physical Activity and Sports Sciences. The results were analysed for 102 students in the 2011/12 academic year (27 female and 75 male), and for 97 in the 2010/11 academic year (26 female and 71 male). Of the students in the 2011/12 academic year, 91 (22 female and 69 male) answered the survey on the resources created. The age interval was 18-33 years.

Description of the instrument

Creating, conducting and analysing the survey to ascertain the students' opinions of the teaching-learning process in the Human Physiology subject using the resources described above. The survey was designed in collaboration with the university's Teaching Support Service and adapted to practical resources.

The survey had four sections, each containing several questions. The students could choose a single answer to each question from the following options: totally disagree, somewhat agree, moderately agree, strongly agree, totally agree. We assessed the following sections:

- Time and effort put into preparation by the students (one question).
- Resource preparation (three questions).
- Quality of resources provided (five questions).
- Knowledge and skills acquired through the methodology (three questions).

The data collected from the survey were tabulated and analysed to obtain the respective percentages for each of the questions posed.

Procedure

The educational resources were made available to the students enrolled at the start of the subject via Blackboard – the university's Virtual Classroom VLE – to guide and support them in doing these practicals.

The process that the students had to follow to do the practicals properly was: to review the resources for each practical, to create the requested resources and to study the theoretical part of the practical so that they would have the necessary knowledge to do the practical on the day.

While the practicals were being done, two lecturers were on hand to answer any queries that the students had about implementing the protocols.

It was crucial to have a series of parameters available in order to determine whether the procedures used in the teaching-learning process were either suitable or needed changing. Parameters like these can be obtained by performing an assessment involving reflection, analysis and decision-making.

Teaching-practice assessment has been shown to be one of the most powerful formative strategies for improving the quality of the teaching-learning process, which enables resource, training and infrastructure requirements to be ascertained, and the students' needs to be identified.

Bearing these premises in mind, a survey was conducted after the students had done the practicals, and the results obtained from it were analysed.

Results analysis

1. Analysis of the student survey

The data collected from the survey were tabulated and analysed to obtain the respective percentages for each item described in the 'Description of the instrument' section.

Time and effort put into preparation by the students

The time and effort put in by the students was assessed as time invested in preparing for the practical using the educational resources created.

Chart 1 shows that nearly half of the students spent an hour on their preparation. The percentages of students who spent two or more hours were very low. It should be noted that a percentage of the students did not specify how much time they had spent, which indicates that they either did count the time or did not spend any time worthy of mention.

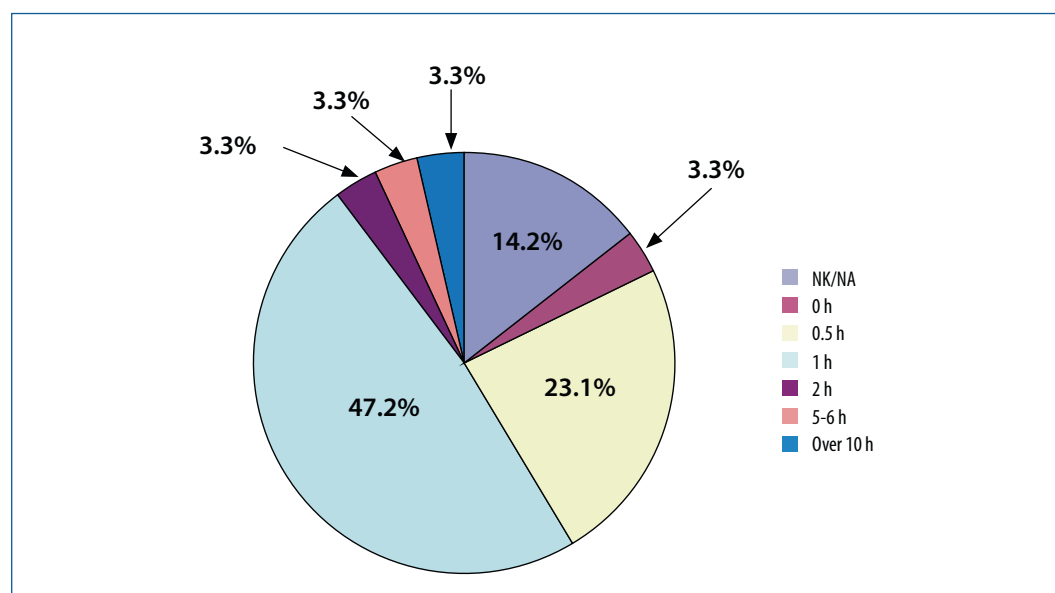


Chart 1. Time and effort put into preparation by the students (percentage of the number of students)

Resource preparation

Regarding the students' needs in order to prepare for the practicals, the opinions shown in Table 2 were obtained.

Table 2. Resource preparation (percentage of the number of students)

RESOURCE PREPARATION (%)	Totally disagree	Somewhat agree	Moderately agree	Strongly agree	Totally agree
A supplementary personal explanation had to be given by the lecturers before doing the practical.	3.3	6.6	39.6	41.8	8.8
The practical work was complemented by contributions made in theory classes and seminars.	0.0	7.7	25.3	48.4	18.7
The time and effort put into preparing for the practicals complemented the theory classes.	1.1	4.4	33.0	49.5	12.1

Regarding the work done in the practicals being complemented by theory classes and seminars, a high percentage of the students agreed (48.4% strongly agreed and 18.7% totally agreed). These percentages indicate that the students perceived good complementarity between what was covered in the theory classes and what was done in the practicals. Regarding the need for an explanation to be given by the lecturers before doing the practical, a moderate percentage of the students agreed (41.8% strongly agreed and 39.6% moderately agreed). This may be related to the small amount of time that the students said they had spent on preparation (as shown Chart 1).

- *Quality of resources provided*

Table 3. Quality of resources provided (percentage of the number of students)

QUALITY OF RESOURCES PROVIDED (%)	Totally disagree	Somewhat agree	Moderately agree	Strongly agree	Totally agree
The resources provided for preparing and doing the practicals were clear and sufficient.	0.0	3.3	14.3	51.6	30.8
The information and bibliography recommended for use in preparing the practicals were available and easy to access.	2.2	9.9	27.5	38.5	22.0
The resources were made available to the students with enough time to prepare for the practicals.	0.0	9.9	17.6	50.5	22.0
The students needed the lecturers' help to understand the resources provided.	0.0	8.8	46.2	33.0	12.1
The use of discussion forums and the sharing of worked-on resources on the VLE facilitated a better understanding of the resources for doing the practicals.	11.0	30.8	28.6	16.5	13.2

A very high percentage of the students agreed that the resources were suitable, clear and sufficient to prepare for the practicals (51.6% strongly agreed and 30.8% totally agreed), that there was enough time to prepare them (50.5% strongly agreed and 22% totally agreed) and that the necessary information and bibliography were easy to access (38.5% strongly agreed and 22% totally agreed).

However, the students moderately agreed with the need to get the lecturers' help to understand the resources, which required a prior explanation (46.2% moderately agreed and 33% strongly agreed).

Regarding the use of discussion forums on the VLE, the percentage of agreement was not high (30.8% somewhat agreed and 28.6% moderately agreed). It should be noted that this resource was not widely used by the students, and that it did not constitute a substantive element of the methodology. The low level of agreement can therefore be considered normal.

- *Knowledge and skills acquired through the methodology*

Another of the important issues in the assessment of the methodology was to determine the level of knowledge and skills acquired through the methodology. The results are shown in Table 4.

Table 4. Knowledge and skills acquired through the methodology (percentage of the number of students)

<i>Knowledge and skills acquired through the methodology (%)</i>	<i>Totally disagree</i>	<i>Somewhat agree</i>	<i>Moderately agree</i>	<i>Strongly agree</i>	<i>Totally agree</i>
The methodology fosters the students' motivation to do the practicals properly.	0.0	3.3	17.6	53.8	25.3
This activity fosters relationships between the students, enabling the work done to be shared and discussed.	0.0	3.3	18.7	45.1	33.0
The preparatory work for the practicals strengthened the students' capacity to search for and select resources.	0.0	12.1	45.1	37.4	5.5

A high percentage of the students agreed that the methodology fostered their motivation to do the practicals properly (53.85% strongly agreed and 25.3% totally agreed), fostered relationships between the students and discussions (45.15% strongly agreed and 33% totally agreed) and strengthened their capacity to search for and select resources (45.1% moderately agreed and 37.4% strongly agreed).

2. Comparative analysis of the grades obtained by the students

In order to assess the students' assimilation of content after using the resources, a test-type exam was set. The exam contained different questions to determine the use made of the resources by the students, both for theory and for doing the practical procedures.

With the aim of getting a more comprehensive assessment of the usefulness of the resources used by the students in the practicals and the methodology followed by them, we performed a comparative analysis using Student's t-test to compare the means of the grades obtained in the practical exam by the students who worked with the resources in the 2011/12 academic year and those obtained in the 2010/11 academic year when a similar exam had been set but the methodology had not been applied.

Chart 2 shows the grades obtained in the practical exam for both academic years.

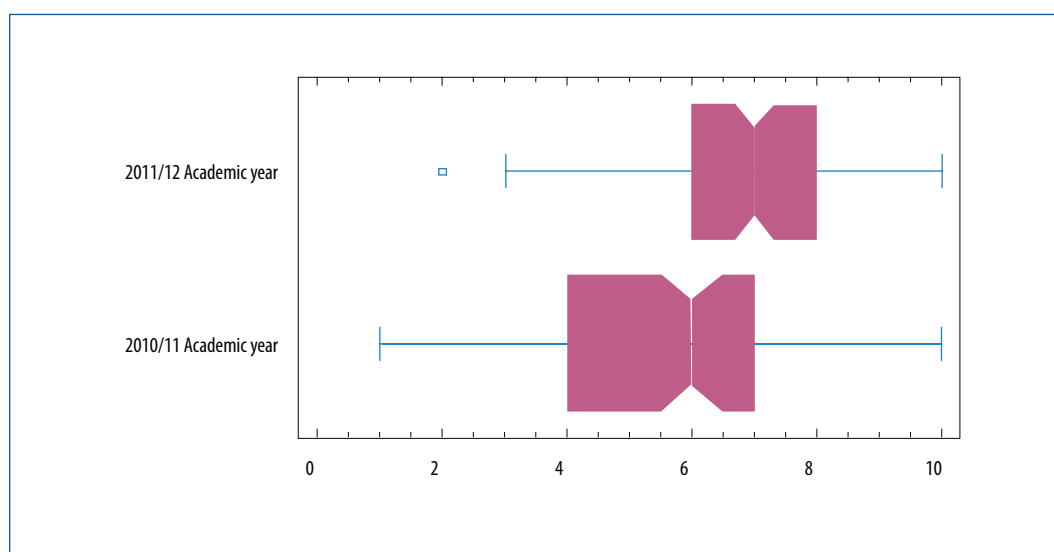


Chart 2. Grades obtained in the practical exam by the students in the 2010/11 academic year (n=97) and the 2011/12 academic year (n=102), whose means were 5.62 and 6.66, respectively. The data were analysed using Student's t-test to compare means: $t=3.82456$; $p=0.00017591$.

A significant improvement was found in the grades obtained by the students in the 2011/12 academic year (n=102 students) in comparison to those obtained in the 2010/11 academic year (n=97 students), as the means were 6.66 and 5.62, respectively ($t=3.82456$ and $p=0.00017591$).

In order to refine these data, we performed a comparative analysis of the grades obtained in the whole subject after continuous assessment, and of the contribution that the practical exam grade had made to the final grade. Chart 3 shows the means of the grades obtained in the whole subject in each of the academic years (2011/12, n=102 students and 2010/11, n=97 students). They were 6.34 and 5.07, respectively. A significant improvement was found in the grades obtained ($t=6.47811$ and $p=1.7828E-7$).

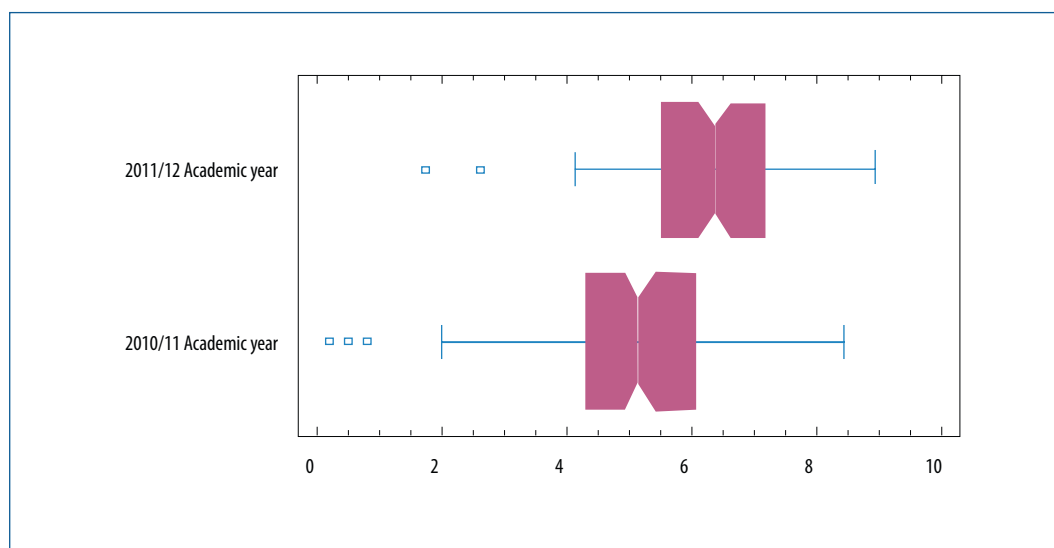


Chart 3. Grades obtained in the subject by the students, after continuous assessment, in the 2010/11 academic year (n=97) and the 2011/12 academic year (n=102), whose means were 5.07 and 6.34, respectively. The data were analysed using Student's t-test to compare means: $t=6.478114$; $p=1.7828E-7$.

Finally, we analysed the contribution that the practicals had made to the theoretical content grade. Chart 4 shows the means of the grades obtained in the theoretical content assessment. A significant improvement was found in the grades obtained in the 2011/12 academic year (5.84) in comparison to those obtained in the 2010/11 academic year (4.43). This would seem to suggest that making better use of the practicals led to an improvement in the assimilation of theoretical content. This study was assessed using Student's t-test to compare means (n=102 in 2011/12 and n=97 in 2010/11; where $t=8.25498$ and $p=0$).

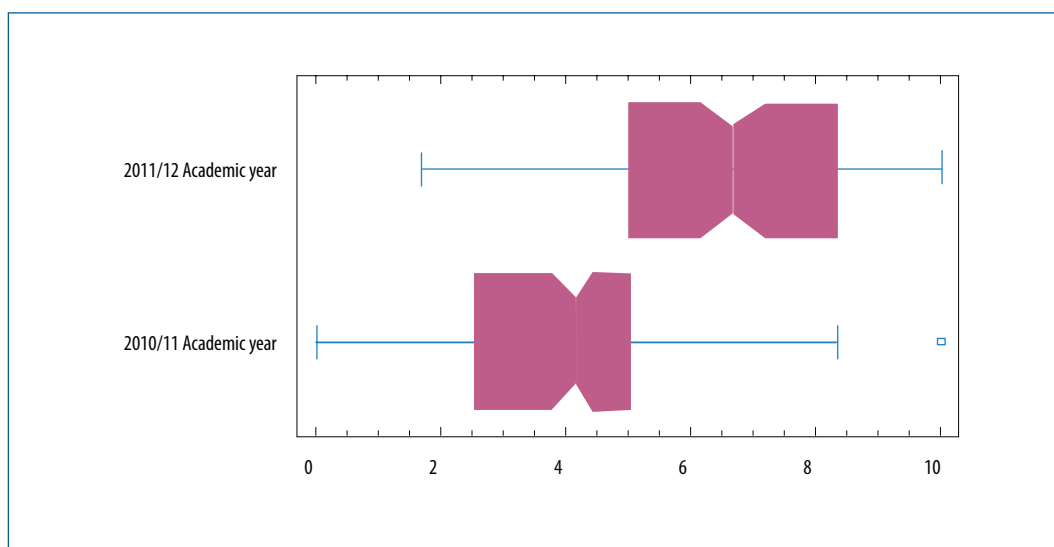


Chart 4. Grades obtained in the theoretical content assessment by the students in the 2010/11 academic year (n=97) and the 2011/12 academic year (n=102), whose means were 4.43 and 5.84, respectively. The data were analysed using Student's t-test to compare means: $t=8.25498$ and $p=0$.

Conclusions

The results obtained in this experience of working with students on practical teaching in the Human Physiology subject have enabled us to approach and, in so doing, move forward in the use of new teaching methodologies with new educational resources.

- On the one hand, the results obtained from the student survey indicated the students' high level of satisfaction with the use of these new tools and with the methodology followed.
- On the other hand, a significant improvement was found in the academic results obtained by the students, not only in the assessment for the practicals, but also in the overall assessment for all the content and competencies.

The first stage of our work, which was the process of creating the resources, gave rise to a considerable improvement in our experience as lecturers, specifically with regard to organising all the information for the practical sessions that we had developed, and then arranging it in video and slide-show format to make it accessible to the students. This creation process enabled us to reconsider important aspects of both the content and design of the practicals, and the importance of conveying information in such a way as to facilitate the students' self-directed learning process through the resources.

In terms of implementing the students' use of these resources and their subsequent assessment by means of a survey, this work enabled us to interact more closely with the students in the teaching-learning procedures, and to become aware of the students' perceptions of the resources that they had used and how useful they had been to them in the process.

In addition, this study enabled a preliminary assessment to be done of the way in which the use of new technologies and new resources in learning helps to motivate the students' attention and strengthen their self-directed work, to facilitate their comprehension and acquisition of knowledge, and to obtain better results in the subject in general. This could be deduced from the comparative analysis of the grades obtained in the subject in the 2011/12 academic year in comparison to those obtained in the previous academic year.

Regarding the need for explanations to be given by the lecturers to enable the students to better understand the resources and work out how to do the practicals (which a percentage of the students requested), two problems became apparent:

- On the one hand, the small amount of time that a high percentage of the students had spent on preparing for the practicals. This indicated that the students had not fully assumed their part of the self-directed work, which new teaching methodologies imply.
- On the other hand, this need for explanations meant that we had to consider improving those resources to make them more comprehensible and accessible to the students.

One of the elements on which there was a low level of agreement was the usefulness of using discussion forums. One of the reasons could be the fact that it had not constituted a substantive

element in the development of the methodology used in this experience and, as a result, the students did not consider the use of this resource a priority. The importance of this tool to the development of competencies such as group work and group construction of knowledge had nevertheless been noted. This made us think about the importance of incorporating it as a key tool in future experiences.

In turn, these considerations present two challenges: helping to strengthen the students' responsible, independent role in the teaching-learning process, and improving educational resources that facilitate the students' work.

In short, considering this experience as a whole, and within the teaching-learning process involving practical teaching in Human Physiology, the use of educational resources based on new technologies represents an important advance in both the students' motivation and work, and in their academic results. In addition, it offers important advantages for lecturers and students alike: creating resources enriches the lecturers' knowledge and teaching skills, and the students' use of those resources strengthens their capacities and skills. Moreover, it optimises time spent on studying and complements the subject content, which leads to better grades. Finally, these resources can be used in practicals for this subject on other bachelor's degree courses, and can be improved by taking into account the opinions collected from the student survey. Their use has enormous potential for both the lecturers' pedagogical practice and the students' knowledge and competency acquisition.

Acknowledgments

This work was funded by the projects UAH/EV428 and UAH/EV451 of the UAH's programme *Proyectos para el fomento y la innovación en el proceso de enseñanza aprendizaje* [Projects for development and innovation in the teaching-learning process].

References

- Adell, J., & Castañeda, L. (2010). Los entornos personales de aprendizaje (PLE): una nueva manera de entender el aprendizaje [Personal learning environments (PLE): a new way of understanding learning]. In R. Roig Vila & M. Fiorucci (Eds.). *Claves para la investigación en innovación y calidad educativas, la integración de las tecnologías de la información y comunicación y la interculturalidad en las aulas* [Keys to research in educational innovation and quality, the integration of information and communication technologies and interculturality in classrooms].
- Area, M. (2005). Internet y la calidad de la educación superior en la perspectiva de la convergencia europea [The Internet and the quality of higher education in the outlook of European convergence]. *Revista Española de Pedagogía*, 63(230), 85-100.
- Bartolomé, A. (2008). Entornos de aprendizaje mixto en educación superior [Blended learning environments at higher education]. *Revista Iberoamericana de Educación a Distancia (RIED)*, 11(1), 15-52.

- Carranza, M., & Celaya, G. (2003). Una estrategia para favorecer la comprensión y el aprendizaje en las ciencias morfológicas: presentaciones en PowerPoint [A strategy to improve the comprehension and learning in morphological science: Powerpoint presentation]. *RELIEVE*, 9(2), 139-159. Retrieved from http://www.uv.es/RELIEVE/v9n2/RELIEVEv9n2_3.htm.
- Flores, O., & De Arco, I. (2012). La influencia de las TIC en la interacción docente y discente en los procesos formativos universitarios [The Impact of ICTs on Lecturer and Student Interaction in University Education Processes]. *RUSC. Universities and Knowledge Society Journal*, 9(2), 31-47. Retrieved from <http://rusc.uoc.edu/ojs/index.php/rusc/article/view/v9n2-flores-arco/v9n2-flores-arco>
- Gallego, R., Palés, J. L., Escanero, J. F., & Sánchez-Barceló, E. (2008). Innovación educativa en la universidad: la enseñanza de la fisiología en el grado de Medicina [Educational innovation in universities: physiology teaching on the bachelor's degree course in Medicine]. *Educació. Informes i Dossiers* 8. Publicacions de la Universitat de València.
- García, E., & Lauretta, D. (2008). Consideraciones metodológicas y organizativas para la preparación y el desarrollo de videoconferencias (VC) con metodología CLIL [Methodological and organisational considerations for the development of videoconferences based on the CLIL didactical approach in a European cooperation perspective]. *Revista Iberoamericana de Educación a Distancia (RIED)*, 11(1), 107-134.
- Margalef, L., Iborra, A., Pareja, N., Castro, B., Domínguez, S., García, I., & Jiménez, S. (2007). Tejiendo redes de aprendizaje y reflexión: una propuesta de innovación en la licenciatura de psicopedagogía [Weaving learning and reflection networks: an innovation proposal on the bachelor's degree course in Pyschopedagogy]. *PULSO*, 30, 123-142.
- Prenes, M. P., Martínez, F., & Gutiérrez, I. (2008). Producción de material didáctico: los objetos de aprendizaje [The production of educational materials: learning objects]. *Revista Iberoamericana de Educación a Distancia (RIED)*, 11(1), 81-106.
- Pagés, T., Blasco, J., Viscor, G., Gallardo, M. A., Carbonell, T., Ibarz, A., Alva, N., & Fernández, J. (2011). Aplicación de metodologías activas para conseguir un aprendizaje profundo [Applying active methodologies to achieve deep learning]. *Buenas prácticas docentes en la universidad. Modelos y experiencias en la Universidad de Barcelona* [Best teaching practices in universities: models and experiences in the University of Barcelona] (pp. 165-178). Editorial Octaedro.
- Pagés, T. (2007). Experiencia en el diseño y uso de plataforma virtual, para el aprendizaje de Fisiología [Experience in the design and use of a virtual environment for Physiology learning]. *Revista de Educación en Ciencias de la Salud (R.E.C.S.)*, 4(1).
- Prudencia, E., Yuste, R., Cubo, S., & Lucero, M. (2011). Buenas prácticas en el desarrollo de trabajo colaborativo en materias TIC aplicadas a la educación [Collaborate on ICT work applied to education]. *Revista de Currículum y Formación del Profesorado*, 15(1), 180-194.
- Salinas, J. (2004). Innovación docente y uso de las TIC en la enseñanza universitaria [Teaching innovation and the use of ICT in university education]. *RUSC. Universities and Knowledge Society Journal*, 1(1). Retrieved from <http://www.uoc.edu/rusc/dt/esp/salinas1104.pdf>
- Zabalza, M. A. (2003-2004). Innovación en la enseñanza universitaria [Innovation in university teaching]. *Contextos Educativos*, 6-7, 113-136.

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